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U.S. DEPARTMENT OF AGRICULTURE FOREST PEST LEAFLET 39
Forest Service Revised December 1965

Pine Root Collar Weevil

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The pine root collar weevil, *Hylobius radialis* Buch., is a native insect injurious to pines in Eastern North America. In the United States it is present in all the States from the Atlantic seaboard south to Virginia and northwestward to Minnesota. In Canada it is found from Newfoundland westward through the southern parts of all the intervening provinces to Manitoba.

The weevil attacks both young and old pines. Infestations become most severe in pine plantations and windbreaks, especially those on poor sites. Natural stands are attacked, but damage is seldom heavy unless the stands are growing near infested plantations. Trees over 1 inch in diameter at the ground line are susceptible to attack. A well-stocked stand rarely supports a heavy weevil population once it has reached crown closure.

Hosts

Several species of native and exotic pines (see list) are susceptible to attack by the pine root collar weevil.

Austrian pine— *Pinus nigra* var. *austriaca* A. & C.
Corsican pine— *P. nigra* var. *calabrica* (Loud.) Schneider.
Eastern white pine— *P. strobus* L.
Jack pine----- *P. banksiana* Lamb.

Lodgepole pine. *P. contorta* Dougl.
Mugo pine----- *P. mugo* var. *mughus* Zenari.
Pitch pine----- *P. rigida* Mill.
Ponderosa pine. *P. ponderosa* Laws.
Red pine----- *P. resinosa* Ait.
Scotch pine---- *P. sylvestris* L.

Scotch pine is the most severely damaged. It is least tolerant to attack and succumbs quickest. Repeatedly infested trees under 4 inches in diameter at the ground line die about 3 to 4 years after the first infestation. Most other species can withstand 5 to 6 years of repeated infestation.

Scotch, jack, and red pine, which are planted extensively within the weevil's range, are among the most heavily attacked. Austrian, Corsican, mugo, lodgepole, pitch, and ponderosa pines are severely injured also, but are not planted as extensively in Eastern North America. Records of pitch pine damage

¹ Insect Ecologists, Lake States Forest Experiment Station and Northern Forest Experiment Station, respectively. The Lake States Station is maintained at St. Paul, Minn., by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of Minnesota.

The original leaflet, issued August 1959, was prepared by the junior author while a member of the Lake States Forest Experiment Station.

indicate that this species is one of the least susceptible hosts. Eastern white pine is rarely attacked unless adjacent to or planted with the highly susceptible species.

Damage

The larval stages injure the bark and cambium of the host around the roots and root collar beneath the soil (fig. 1). This weakens the tree



Figure 1.—Root collar of young red pine severely injured by larvae of the pine root collar weevil.
(Courtesy of Paul Flink, Michigan Conservation Department)

and restricts growth and transport of nutrient. Heavy winds or snow cause weakened trees to lean or blow over at the ground line. Heavily girdled trees die standing and disintegrate.

A swollen trunk at the ground line and darkened, pitch-infiltrated soil around the root collar characterize an advanced infestation. Duff and a few inches of topsoil must be scraped away to detect the injured root collar.

Adult weevils feed on the bark of the twigs but cause no appreciable injury.

Reduction in height growth is the first sign of damage to young pine trees from larval feeding. In an even-aged stand, a moderate to heavy insect population is usually present when the leader growth of some of the tallest trees about equals the leader growth of the shortest trees. A few dead and dying trees (yellowing) indicate a severe infestation. A continued high infestation can wipe out the entire stand.

Description²

The oval egg is about 2 mm. long by 1.2 mm. wide and nearly white to pale yellow. The embryo, when well developed, can be seen through the transparent shell.

The larva is white with an amber-

² This description of the egg, larva, and pupa is identical to that of the egg, larva, and pupa of several species closely related to and often associated with the pine root collar weevil. The small differences in structure required to separate them are beyond the scope of this leaflet. The description given here will determine if the specimen belongs to this group of insects.

brown head capsule (fig. 2,A). It is legless and rests with its body in a curved position. When fully grown, it measures about $\frac{3}{8}$ to $\frac{1}{2}$ inch long.

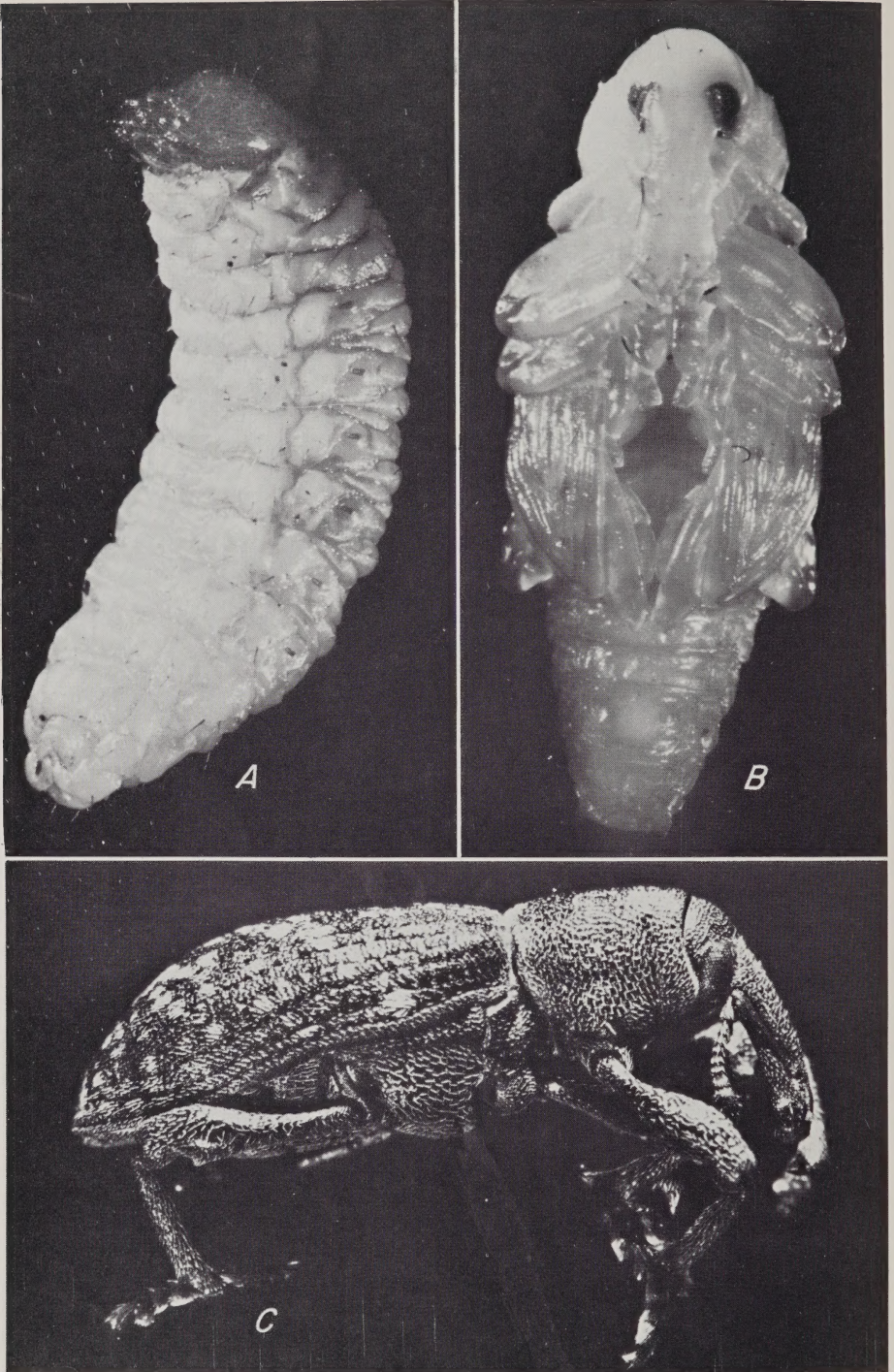
The pupa (fig. 2,B) resembles the adult insect superficially and is about the same size. At first it is yellow white and very delicate; and the mouth parts, antennae, legs, and wings are incompletely formed. As development continues, the appendages become more distinct. The body hardens and darkens, first becoming light brown, then deepening to a red brown by time of emergence.

The adult weevil (fig. 2,C) is an elongate, snout beetle, dark reddish brown to nearly black. It is marked with irregular patches of white-to-yellow hairlike scales. The wing covers have longitudinal rows of elongated indentations. Its length varies from $\frac{3}{8}$ to $\frac{1}{2}$ inch.

Life History and Habits

In most localities, eggs are laid from early May to late September, the peak occurring about late June to early July. They are deposited singly in cavities in the inner bark at the base of a tree or in the soil nearby. An average of 30 eggs is laid during the lifetime of the female adult.

Larvae hatch after 2 weeks. They penetrate the bark, then feed and excavate downward, widening their irregular gallery as they develop. Galleries are also made in the soil around the collar and are thought to serve as refuge during molting periods and perhaps for use in removing some excess pitch flowing from the injured tree.



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Figure 2.—Pine root collar weevil: A, Fully developed larva; B, pupa; C, adult. (About 8 × actual size.)

Larvae overwinter in galleries in the root collar in the third to last instars and complete development the next season.

Pupation occurs from early June to September, in a cell out in the soil. Adults emerge from August to October. Little, if any, egg laying occurs before winter. Adults overwinter in the soil or in bark crevices and resume activity at the beginning of warm weather in spring. Adults are seldom seen since they rarely fly, remaining near the base of the tree during the daytime. There they feed on the bark of the duff-covered branches, mate, and lay eggs. During warm evenings they feed on the bark of the upper branches and travel to other trees. Most adults overwinter a second time and then are active for part of the following season.

In some localities the life cycle becomes complicated because some larvae from eggs laid in early May complete their development in time to pupate in the fall. These overwinter and emerge early the following year. In such areas, nearly all stages of development can be found during most of the year. All stages except eggs and very young larvae can be found in the winter.

Similar and Associated Insects

One or more of at least seven species of weevils and one species of bark beetle may be present on the same trees inhabited by the pine root collar weevil. All resemble *Hylobius radialis* in either the adult or larval stages, but most have different habits. Only experts can identify most of them.

Two species, *Hylobius pinicola* Couper and *H. warreni* Wood, cause damage similar to the pine root collar weevil. However, *H. pinicola* prefers older trees and wetter sites, and also attacks spruces and tamarack. Another closely related species, *H. rhizophagus* Millers, develops only in the roots of living pines. Little is known about another species, *H. congener* Dalla Torre.

Hylobius pales (Herbst) and *Pachylobius picivorus* (Germar) breed primarily in roots of dead and dying pines. *H. pales* pupates in cells constructed in the wood, and the adults feed commonly on the bark of seedlings.

The weevil *Pissodes approximatus* Hopkins and the bark beetle *Dendroctonus valens* Leconte breed in weakened trees and may be present on pines infested by the pine root collar weevil. Their damage, however, is commonly found above, as well as below, the ground line.

Natural Control Agents

In general, the cryptic stages of the pine root collar weevil are well protected from biological and climatic hazards. Eggs in the soil are subject to attack by mites and insect predators. Ants are frequently common at the base of the tree and probably consume eggs and young larvae. One species of hymenopterous parasite has been reared from the eggs.

Larvae emerging from the eggs in the soil may die from starvation if not established in the host tissue within 3 or 4 days after hatching. Larvae nearest the ground line

are occasionally attacked by two hymenopterous parasites, *Bracon radialis* Shenefelt and *Coeloides* sp. Infrequently a larva is found diseased or entrapped in pitch in its gallery.

Excessive rain during one season was responsible for 15-percent pupal mortality in Ontario, Canada. A bacterial disease has also caused some deaths of pupae.

Adults that appear diseased are occasionally obtained from the pupal cells. A carabid beetle, *Pasimachus elongatus* Lec., has been observed feeding on the adult weevil. Overwintering mortality has not been detected for adults or larval stages.

None of the biological or climatic agents is reported effective in controlling pine root collar weevil populations.

Silvicultural Practices

Populations of the pine root collar weevil have apparently been reduced in some locations by following these practices:

1. Whenever possible, avoid planting the highly susceptible pines on sandy soils where the pine root collar weevil is present.
2. Avoid mixed pine plantations. Pine root collar weevil populations build up on the more susceptible pines and later attack and injure the more resistant ones.
3. Plant trees shallow so as not to provide a deep root collar.
4. Cut open-grown, older susceptible pines before planting.
5. Maintain fully stocked stands in high-weevil-hazard areas.
6. Pruning the lower 2 feet of branches and raking away the duff

beneath a tree shows some promise of control in heavily infested plantations. This hinders the normal daytime activities of the adults.

Insect Survey

Before control is attempted, the insect population level in a stand should be determined by surveying. A moderate to heavy insect population exists when the trees average at least three or four insects per root collar. A simple, yet reliable, method for estimating the average number of insects per root collar is to determine the percent of trees infested. A tree is considered infested if it contains at least one larva or pupa in the root collar or surrounding soil. Pitch-infiltrated soil alone is not a sure indication of a current infestation. Similar symptoms are caused by infestations from previous years and by root diseases. About 20 to 25 trees in a plantation must be examined from areas picked at random. If 80 to 85 percent of the trees examined are infested, there are at least three larvae per root collar on the average, and control practices should be considered.

Chemical Control

Dieldrin or lindane is recommended for pine root collar weevil control. The emulsifiable liquid concentrate gives best results. Use sufficient concentrate to make a formulation containing either 2 pounds of actual dieldrin or 1/2 pound of actual lindane in 100 gallons of water. (Prepare proportional amounts for smaller doses.)

Apply the insecticide by cup, backpack sprayers, or hydraulic

sprayers. Pressure sprayers are best because penetration of the litter and upper soil is increased without wasteful runoff. Either mixture is applied to the lower few inches of the trunk, and to the soil surrounding the tree out to 8 inches. About 1 pint is needed for each tree under 8 feet tall—slightly more for taller trees. Chemical treatments are directed against the adult weevils. Chemicals should be applied in late May or early June before the weevils begin egg laying.

The impact of the treatment will not be fully realized until after the larvae in the tree have been killed as emergent adults. Control in excess of 95 percent can be expected for at least 4 years following treatment.

The control method described here is slow and expensive and is recommended primarily for high-value plantations and windbreaks, particularly if they are near or contain the highly susceptible pine species. Christmas tree growers will need only one application per rotation. Windbreaks and most forest plantations may need additional applications later. Well-stocked, fast-growing plantations, however, may need only one application if it keeps the trees healthy to crown closure, at which time the insect population usually declines.

Caution: If you use insecticides, apply them only when needed and handle them with care. Follow the directions and heed all precautions

on the container label. If insecticides are handled or applied improperly, or if containers and unused portions are disposed of improperly, they may be injurious to humans, domestic animals, desirable plants, honey bees and other pollinating insects, fish, and wildlife. Also, they may contaminate water supplies.

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